

THE
Description and Use
OF
A Portable Instrument

Vulgarly known by the Name of

GUNTER'S Q^uadrant

By which is perform'd most Propo-
sitions in *Astronomy*; as, the Altitude,
Azimuth, right Ascension and Declina-
tion of the Sun, &c. also his Rising and
Setting and Amplitude, together with
the Hour of the Day or Night, and other
Conclusions exemplified at large.

To which is added,

The Use of NEPIER'S Bones in
*Multiplication, Division, and Extraction of
Roots*; also the Nocturnal, the Ring Dial,
and Gunter's Line, in many necessary and
delightful Conclusions, fitted to the Under-
standing of the meanest Capacities.

*Collected and digested into this portable Volume
for the Use of young Practitioners.*

By WILLIAM LEYBOURN.

The Second Edition.

London, Printed for J. Wilson, at the Gun-
Dragon in Little-Britain. 1721.



The USE of a
Portable Instrument,

Known by the Name of

GUNTERS
QUADRANT.

SECTION I.

Of the Description thereof.

1. **T**Here needs no large Description of this Instrument for all Persons that are capable of the use thereof know; 'tis but the fourth part of a Circle, and divided in the Limb thereof into 90 degrees by Equal divisions, and Numbered 10. 20. 30. 40. &c. unto 90, each degree being subdivided into 4 parts, above
A 2

2 *The Use of a Portable Instrument,*
the Limb; there is Inserted the
Twelve months of the year, and Dis-
tinguished by Capital Letters, viz. *J.*
for *January*, *F.* for *February*, *M.* for
March, &c. and each month is sub-
divided into 5 days, more or less
according as the largeness of the *Qua-*
drant will bear, and then above the
days of the Month you have in the
Body of the *Quadrant*, the *Hours* and
Azimuth Lines, together with part o
the *Ecliptick* and *Horizon*, also a *Qua-*
drant, &c. as will be much more ob-
vius and Intelligible to the Reader
by Inspection of the Figure there-
of hereunto Annexed, then many
words.

3. And to make the *Quadrant* com-
pleat there must be added a Couple
of Brass eights with small holes there-
in, fixed to one of the Semidiameters
of the *Quadrant*, also a Thred or Sil
fastened to the Center, with a Bead and
Plummet as is usual, and the making
hercof is well known to the work man
and

and shewed at larg by Mr. Gunter.
What else is necessary shall be Explained in its use.

SECT. II.

Of the Circle of Months.

THIS circle of months is Figured with the Letters *J. F. M. A. M. &c.* signifying the Months *January, February, March, Aprill, May, &c.* each month being Divided unequally according to the Number of the Days that are contain'd therein, as before Intimated

(1) *And now to find out any day of the Month throughout the year, First search out the Month, and from the beginning thereof account the small Divisions from one Month to another each of them, for five days, unless your Quadrant be Larg and the Month*

4 *The Use of a Portable Instrument,*
divided to every day) and by this
means you easily find the place (or
Division) of the Day of the Month
desired, which will be much easier by
practice, then can be express'd by
words, and here note, that every 10th
day is distinguished by a longer Line
then the rest, thus, if I lay the Thred
(being fixed in the Center) to the
10th. day of *January*, 'twill cut in a-
bout 21 degrees in the Limb of the
Quadrant: Now in *June* and *December*,
when the *Sun* has his greatest *North* or
South Declination: The Divisions
here run close and so the Day of the
Month cannot be so exactly found
but guesed at, and near enough for
most Uses, but in all the other Months
of the year, there needs not the least
Scruple in this particular.

(2) *Having*

- (2.) Having the day of the Month to find out the Suns Meridian Altitude, or how high he will be at Noon.

Let the Thred be laid upon the Division called (or Representing) the Day of the Month, and then that very Degree which the Thred cuts in the Limb of the Quadrant is the Suns Meridian Altitude required; So the Thred laid to the 15th. day of May will cut 59. gr. 30. M. in the Quadrants Limb which is the Suns height that day at Noon, and if it be laid upon the 18th. day, the Meridian Altitude will be found 41. gr. 39. quarters.

- (3.) The Meridian Altitude being known, to find the day of the month, which is the converse of the former.

The Thred being laid upon the Meridian Altitude, doth also fall upon the

6 *The Use of a Portable Instrument,*

the day of the Month: So that if you have any one of them you have both; So if the Altitude at noon be 59 gr. 30. min. (as before) and the Thred being set thereunto, it falls upon the 15th. of *May* and the 9th. of *July* and which of these two is the true day may be distinguished by the Quarter of the year, or another days observation. For if the *Altitude* prove greater, the Thred will fall on the 16th. day of *May*, and 8th. day of *July*, or if it prove lesser the Thred will fall on the 14th. day of *May* and the 10th. of *July*, and thus the doubt is fully determined, and by this we discover also what days of the year are of equal length, which must needs follow by Consequence if the Meridian Altitudes be equal, and so the 5th. of *September* and 18th. of *March* have the same *Meridian Altitude*, and the same Length which is to be understood in in the rest of the Months, as they stand

stand opposite in their proper Circles.

(4.) And here 'tis to be observed that this *Quadrant* is Accomodated but to one *Latitude*, and therefore (in this case) serves but for one place, and such which lye parallel thereunto viz. east or west from thence (as suppose from the *Metropolitan City of London*) those that lye 60 or 70 miles North from this Parallel, the *Sun* will be a degree Lower, then appears by the *Quadrant* at Noon, and the contrary one degree higher for the meridian *Altitude* to such as live 60 or 70 miles South from *London*; or such places that lye parallel to it, this is to be understood if you be Regulated by the day of the Month upon the *Quadrant*.

(5.) But if you observe the *Suns Altitude* just at Noon (or a little before, and a little after Noon) by holding the *Quadrant* in both your hands turning
A 5 your

8 *The Use of a Portable Instrument,*

your left hand towards the *Sun*, so that the Beams thereof may pass through the holes of the sights, then the Plummet hanging at liberty, the degrees cut in the Limb by the Thred is the Altitude desired in any place, and the same may be done by the *Moon* and *Stars* if you look through the sights at the *Moon* or *Stars*, and observe then what degrees are cut by the Thred in the Limb, so upon the 14th. day of *April* just at Noon, the *Sun* Beams passing through both the sights, the Thred will fall upon 51 gr. 20 min. the true meridian Altitude of the *Sun* in the Latitude of *London*, for which meridian most of these *Quadrants* are made.

SECT

SECT. III.

Of the Hour Lines on the Quadrant.

(1) **O**bserve that the *Arch* drawn upon the *Center* of the *Quadrant* to the beginning of the *Suns* Declination doth Represent the *Equator* or *Æquinoctial* circle (and is usually made a *Radius* or *Tangent* of 45 degrees; But that Arch which is drawn by 23. degrees 30 min. of Declination, and is just above the Circle of *Months* and days Represents the *Tropick*, of *Capricorn* and *Cancer* or the *Suns* Greatest Declination both North and South, and those Arch-Lines which are described upon the *Quadrant* between the *Equator* and the *Tropicks*, being undivided and Numbered at the *Equator* by 6, 7, 8, 9, 10, 11, 12, and at the *Tropicks* by 1, 2, 3,

To The Use of a Portable Instrument

2, 3, 4, 5, 6, 7, 8, Those very lines or Arches are the Hour-Circles.

(2.) That which is drawn from 12 in the Equator to the middle of *June*, Represents the hour of 12 in the *Summer*, and those which are drawn with it towards the Right hand are the Hours of the day in *Summer*, and also of the Night in *Winter*. But that Arch which is drawn from 12 in the *Equator* to the middle of *December* Represents the hour of 12 in the *Winter*, and those Arches with it to the left hand the rest of the Hours of the day in *Winter*, and night in *Summer*, and of both these, that which is drawn from 11 to 1, serves for 11 in the *Forenoon* and 1 in the *Afternoon*, That which is drawn from 10 to 2, serves for 10 in the *Forenoon* and 2 in the *Afternoon*, the Reason is that the same day the Sun has the same Altitude 2 hours before noon, as 2 hours after noon

called Gunter's Quadrant.

noon, and the same reason is to be understood in all the rest which is plain and easily understood as by the following Propositions will clearly appear.

(3.) *The Day of the month or Meridian Altitude of the Sun being given to find the Place of the Sun in the Ecliptick.*

Let the Thred be laid to the day of the Month or to the Sun's height at Noon (for the one gives the other) observe then where it crosses the hour of 12, and set the Bead to that Intersection, then move the Thred till the Bead fall on the Ecliptick circle (which is known by the Characters of the 12 signs) and it will fall upon the Sun's place & so if it were the 15th of May, or Meridian Altitude 50 gr. 30 min. Lay the Thred as aforesaid, and put the Bead to the Intersection of

12 *The Use of a Portable Instrument*

of the Hour of 12, and then move the Thred till the Bead fall on the *Ecliptick*, and it will there touch upon the 4th. degree of *Gemini* and the same of *Sagittary*, also the 26th. of *Cancer* and the 26 degree of *Capricorn*, and which of these is the place of the Sun, may appear by the *Quarter* of the year, or another days *Observation*.

(4.) *To Rectifie the Bead for the hour of the day, &c.*

Knowing the day of the Month, place the Thred thereon, and then slip the Bead to the Meridian or hour of 12, for the season of the year, then you are fitted to find the Hour by the *Sun*, but for the *Stars* only lay the bead upon the Star-proposed. And thus the Bead being Rectified if you do but observe the *Altitude* of the *Sun*, the Bead will fall on the Hour
Line

Line desired, or sought, if you bring the
 Thread the Altitude: So on the 10th of
April having Rectified the Bead for the
 time, you may find the Altitude 36 gr.
 at the same time the Bead falls upon
 the Hour line of 3 and 9, and then I
 may conclude 'tis 9 in the Forenoon,
 or 3 in the afternoon, and so upon
 the 9th. of *April* the Bead being
 Rectified and the Altitude observed 3
 gr. the Bead will fall between 8 and 9
 in the *Æquator* and between 3 and 4 in
 the *Tropicks*, so that 'tis half an hour
 past 8 in the Morning or half an hour
 past 3 in the afternoon, and here ob-
 serve if the *Sun* ascends, it is before
 Noon, but if the *Sun* descends or falls
 in Altitude, 'tis afternoon as *Reason* it
 self will direct; so again upon the a-
 foresaid 10th. of *April*, if the *Sun*s
 Altitude be 40 degrees you will
 find the Bead at the same time
 fall half way between the hour
 Lines 9 and 3 and 10 and 2,
 where-

14 *The Use of a Portable Instrument.*

wherefore it must either be half an hour past 9 in the Morning, or half an hour past 3 afternoon, which is most easily Distinguish'd. And after the same Method if upon the first of *November* I observe as aforesaid, and find the Bead to fall half way between 8, and 9, and 3 and 4 in the winter Hour circles: Hence I conclude 'tis half an Hour past 8 in the forenoon, or half an hour past 3 in the afternoon *et sic de ceteris.*

(5.) *The place of the Sun in the Ecliptick being known to find the day of the Month.*

Lay the Thred and Bead on the place of the Sun in the *Ecliptick* & then move the Thred and Bead to the hour of 12, and so if the place of the Sun be 4 degrees of *Gemini*, the Bead being laid to this degree, and then moved to the hour of 12 in *Summer*, the Thred will fall on the 15th. day of *May* or the 9th.

called Gunters Quadrant.

15

9th. of July: or if it be moved to the hour of 12 in winter, the Thread will fall on the 6th. of January and the 16 of November and which of these is the day of the Month required, the Quarter of the year will determine.

By this and the third Proposition there is two ways shewed to Rectifie the Bead by the place of the Sun, and by the day of the Month, and the best way is accounted by the place of the Sun; for in the other some small difference may arise by the Leap-year. There is also a Third way by a Table of the Suns declination for each day of the year (which Seamen are seldom without) and if so, the Bead may be set thereunto in the Line of declination.

16 *The Use of a Portable Instrument.*

(6.) *To know how high the Sun will be at any hour of the day given throughout the year.*

The Bead being Rectified for the Time, by any of the ways aforefaid; Bring it to the hour given from the hour of 12 towards the Line of declination, and the degrees cut by the Thread in the Quadrant or Limb thereof, will shew the Altitude of the Sun at that time, so upon the 30th. of *March* at 8 in the Morning, and 4 in the afternoon, the Sun will be found to be 24 grad. 30, min. high; Again, on the 10th of *April* the Sun being in the beginning of *Taurus*, the Bead being Rectified you shall find the Altitude at Noon at *London* 50 gr. 0 min. But at 11 in the Morning 48 gr. 12 min. at 10 of the Clock but 43 gr. 12 min. at 9 only 36 gr. at 8 of the clock 27 gr. 30 min. at 7, but 18 gr. 18 min. at 6 in the

called Gunter's Quadrant.

17

The Morning, but 9 gr. and at 5 a clock
it touches the Line of Declination,
and has no Altitude at all, whence we
may conclude the Sun did Rise much
about that Hour. And then if you
move the Thred again from the Line
of Declination towards the Hour of
12, you shall find the Sun 8 degrees, 15
min. below the Horizon at 4 in the
Morning, and near 16 gr. at 3 and 21
gr. 51 min. at 2, and 25 gr. 40 min.
at 1, and 27 degree at Midnight. For
the Bead being Rectified as aforesaid
and brought to the Hour of the Night
(which as before was intimated are
the winter Hours in Summer and the
Summer hours in winter) then the
Thred in the Limb cuts the degree of
the Sun's Depression for any hour of
the night, and thus 'twil be found that
at 11 of the Clock at night the 30th
of March the Sun will be found at
least 28 degrees and 30 min. below
the Horizon.

7 The

28 *The Use of a Portable Instrument,*

(74) *The Hour of the Night given to find the Suns Depressment* / And here let it be Observed that the Sun is always as much below the Horizon at any hour of the Night, as his opposite point is above the Horizon at the like hour of the day, and therefore (to make this more plain) The Bead being set, if the Question be put for any Hour of the Night in the Summer, then move it to the like Hour of the day in the Winter Hours: But if of any hour of the Night in Winter, then move the Bead to the like Hour of the day in Summer, and so the Degrees cut by the Thred in the Limb of the Quadrant shall shew how much the Sun is below the Horizon at that Time, and so suppose it the 10th. of April at 4 of the Clock in the Morning, the Bead being set to his place according to the Time in the Summer hours, and brought

called Gunter's Quadrant. 19

brought to 4 of the clock in the afternoon in the Winter hours, you will find the Thread to cut 8 deg. and about 30 min in the Limb of the Quadrant which is the true depression of the Sun at that time.

(8.) The Depression of the Sun supposed to give the Hour of the Night with us, or the hour of the day to our Antipodes.

In Regard the Sun is as much above the Horizon at all hours of the day, as his Opposite point is below the Horizon at the like hour of the Night: Therefore first set the Bead according to the Time, and then bring the Thread to the degree of the Sun's Depression below the Horizon, so shall the Bead fall on the contrary Hour Lines, and there shew the Hour of the Night in respect of us which is the like hour of the day to our Antipodes; So

20 *The Use of a Portable Instrument,*

So the 10th. of *April*, the Sun being then in the begining of *Taurus*, and by Supposition, 8 gr. 30 min. below the Horizon in the East, it is required to know, what time of the Night it is, first set the Bead according to the day in the Summer hours, then bring the Thred to 8 gr. 30 min. in the Limb of the Quadrant so shall the Bead fall among the Winter hours on the Line of 4 of the Clock in the afternoon, wherefore to our *Antipodes* 'tis 4 of the clock in the afternoon and to us 4 in the Morning.

(9.) Having the time of the year, or the place of the Sun, being known, how by this Quadrant to find the Beginning of Day break and end of Twilight.

There is very little Difference between this proposition and the former; for the day is said to Break when the

the Sun comes to be but 18 deg. below the *Horizon* in the East, and Twilight to end when the Sun is 18 deg. below the *Horizon* in the West, wherefore let the Bead be set for the time, and then bring the Thred to 18 gr. in the *Quadrant*, so shall the Bead, falling upon the contrary hour Lines, there shew the hour of *Twilight* as before in the operation of the last proposition, and so 'twill be found a little more then a Quarter after 3 in the Morning, for day break upon the 10th. of *April* after the same manner upon the 30th. of *March* day break will be found to be at 3 of the clock in the Morning, and if so we may easily Judg when 'twill be dark at Night, which is said to be as much after 6 as this before 6, and then we may conclude 'twill be dark at 9 of the Clock at Night, it being then past *Twilight*.

SÉCT. IV.

Of the Azimuth Lines.

(1.) **O**bserve that those Arching-Lines which are drawn between the Æquator and the Tropicks on that side of the Quadrant towards the right hand or nearest to the sights, and are Numbered with 10. 20. 30. 40. &c. in the Æquinoctial, then downwards from the Æquator to the Tropick with 110. 120. 130. &c. The uttermost towards the left hand Representeth the *Meridian*, that which is Numbered with 10 the tenth *Azimuth* from the Meridian, and that which is Numbered with 20 the 20th. and so of the rest. Those Lines which are drawn from the Æquator to the left hand do shew the *Azimuth* in the *Summer*, and those other to the Right hand,

band do shew the same in the Winter,
the uses of them follow.

(2) *The Azimuth the Sun is upon, being known, to find the Altitude of the Sun above the Horizon.*

First let the Bead be set for the Time, as before is shewed, then move the Thred until the Bead fall on the *Azimuth*: So the degrees which the Thred cutteth in the *Quadrant* shall shew the Altitude of the Sun at that time, where you are to observe that, in regard the *Azimuths* are drawn on the Right side of the *Quadrant*, you are also to begin to Number the Degrees of the *Suns Altitude*, from the Right hand towards the left, contrary to the Directions of some former propositions. Examples will clear this point: Suppose the Time given were the second of *August*, when the *Sun* hath but 19
B deg.

44 The use of a Portable Instrument,
 deg. of North Declination, Set the
 Bead for the time and the Suns Meri-
 dian Altitude or height at Noon will
 be found 53 gr. 30 min. but when he
 is 10 gr. from the South 53 gr. 10 min.
 when 20 gr. then about 52 gr. 8 min.
 when 30. then 50 gr. 20 min. when
 40, then 47 gr. 28 min. when 50,
 then 44 gr. 12 min. when 60. then
 39 gr. 34 min. when 70 then 33 gr.
 50 min. when 80, then 27 gr. when
 the Sun is in the east or west 90 gr.
 from the Meridian then is the Alti-
 tude near 19. 20 min. when 110.
 then 3 gr. 20 min. and before he
 cometh to the Azimuth 120 gr. he
 has no Altitude for the Sun having
 24 gr. of North Declination will
 Rise and Set at 114 gr. 34 min.
 Azimuth from the Meridian.

- (3) *The Altitude of the Sun being given to find, on what Azimuth or point of the Compass he bears from us.*

Set the *Bead* in his proper place for the day proposed (as before Directed) and then Observe the Sun's Altitude, then lay the Thred to the Complement of that Altitude, (which is but Accounting so many degrees from 90 deg.) on the *Quadrant*, so shall the *Bead* fall upon the true *Azimuth* required. *Example*; Suppose upon the second of *August* (having Rectified the *Bead*) you observe and find the Sun's Altitude to be 19 gr. 20 min. Then Remove the Thred to the Complement thereof viz. 70 degrees. 40 min. or which is all one upon 19 gr. 20 min. accounted from 90 degrees from the right hand to the left, and the *Bead* will fall upon 90 degrees from the Meridian, and there-

26 *The Use of a Portable Instrument,*

fore the point the *Sun* is upon bears from us, either Full *East* or Full *West*, & which of these it is may immediately be discovered by a Second observation; for if the *Sun* increase in Altitude 'tis Forenoon, and the *Azimuth* East. If the *Sun* Decrease in Altitude 'tis Afternoon, and then the *Azimuth* is West, which is as easily discovered, by the Hour of the day: And so again, If I find the *Sun*s Altitude to be 25 *degr.* if I lay Thred to 25 *degr.* Accounted backward from 90 *deg.* the Bead will upon e y near 80 *deg.* from the South, and that is the point of the compass the *Sun* is upon Eastward, if in the Morning, and Westward if in the Afternoon. By these propositions you may know the Altitude of the *Sun* every hour of the day, though he appear not, and what part of the Heavens he is in likewise, and then knowing what *Azimuth* the *Sun* beareth from us you may find not only

only a Meridian Line, but the Coast-
ing of a Country, the Scituation of a
Building and the variation of the
compass, &c. As for *Example*, Suppose
some day in the afternoon I should
find by the aforesaid Direction, that
the *Sun* bears from me 60 degrees
from the South towards the West,
then there being 90 deg. in each Quar-
ter of the compass, the West will ap-
pear to be 30 deg. to the Right hand,
the East is just opposite to the West,
and the Meridian Line or North and
South lye in the midst between them.

4 To find the 4 Cardinal points upon an
Horizontal Plain.

First find the *Azimuth* of the *Sun*,
and instantly lay your *Quadrant*
upon the Plain, so that the Face there-
of may lye uppermost, then hold in
your hand some small string with a
Plummet hanging thereunto, and Move

28 *The Use of a Portable Instrument.*

the *Quadrant* till the Sun casteth the shadow of the string through the degree of the Limb which was found for the *Azimuth*, and through the Center of the *Quadrant*, then holding the *Quadrant* still draw right Lines by each side thereof, and protract them, so that they may Cross each other, and these Lines shall point out *East*, *West*, *North*, and *South*.

(5) If two several Sun shadows be Observed the one in the forenoon, and the other in the Afternoon of the same day, exactly to touch with their ends, the Circumference of the same circle described in a Plain, Parallel to the Plain of the Horizon; The Line from the Center Equally dividing the the Arch of that Circle betwixt the two shadows will be the true Meridian in that place.

This is a Useful Theorem and may
be

be better understood by Example viz.
 Take a piece of Board or Mettle and
 let it be so evenly placed, that it may
 lye parallel with the Plain of the
 Horizon: In this Plain Describe di-
 vers Circles from the same Centre,
 and in that Centre, raise a Gnomon
 at Right Angles. This Platform be-
 ing thus Ordered let the shadow
 of the Gnomon or wire be observed
 sometimes beforenoon, till such time
 it do exactly touch the circumference
 of one of these Circles. Again in the
 afternoon let the shadow be Obser-
 ved till the end of this Perpendicular
 touch the Circumference of the same
 Circle, which will exactly happen
 so many hours afternoon, as the
 other beforenoon, then you are di-
 ligently to Observe these two points
 in the Arch of the said circle and di-
 vide that Arch into two equal parts
 by a Line from the centre, this very
 Line is a true Meridian Line, upon
 B 4 which

30 *The Use of a Portable Instrument,*
which when the shadow falls, you
may be sure 'tis just 12 of the clock,
or just high Noon.

6 *To find the Declination of a Wall
for the making of a Declining Dy-
all:*

Apply one Edg of the Quadrant to
the Wall, and at the Limb hold up a
Thred and Plummert, so that the shadow
thereof may pass through the
Centre then mark what degree of
the Limb the shadow of the String
so held shall touch, then presently find
the Degree in the Limb of the *Suns*
Azimuth at that time; then if you
have done right, the degrees between
the degree of the *Azimuth* of the *Sun*
and the degree of the shadow of the
string, so mark'd, shall be the degree
of the Declination of the wall from
the true Meridian, which whether it
be *Eastward* or *Westward* may be
known

known by comparing it with the *Sun*.
And not, this proposition may be the
better performed the farther the *Sun*
is from the Meridian.

7 To find how much a plain or Wall de-
clin's from th. Zonith.

Apply the Edg of the Quadrant to
the *Plain* or *Wall*, so that the Center
may be downwards and the Limb up-
wards, then hold a String and Plum-
met; so that the Thred or String may
touch the Centre and the Limb, and
Number the Degrees between the
Plain and the string, and they shew
the Quantity in Degrees of the Plains
Reclination.

8 To find the Elevation of the Pole in
any Place.

First take the Meridian Altitude of
the *Sun* by Observation, (or other-
wise)

...the *Equinoctial* height, which Subtracted
wife) and also the *Suns* Declination
(as shall be shew'd) which if it be
Northwards then *Subtract*, if *South-*
wards, add to the *Suns* Meridian Al-
titude, and you have the comple-
ment of the Poles Elevation, or the
Equinoctial height, which Subtracted
out of 90 degrees, leaves the *Lat-*
tude of the Place desired, which is so
Plain it needs no Example.

SECT. V.

Of the Ecliptick Circle or Arch.

(1) **T**HE *Ecliptic* is easily distingui-
shed from the other Circles,
and is Represented by the Arch to
which is annexed the Characters of
the 12 signes, and is drawn from the
Hour-Line of 6 in the *Equator*, to the
other side of the *Quadrant* ending in
the Tropicks of *Cancer* and *Capricorn*,
each

each sign being divided unequally into 30 deg. which is to be reckoned both ways from the Characters of the 12 Signs, *Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittary, Capricorn, Aquary, Pisces*, which Signes do also answer to the 12 Months, and the Thread being layd upon the day of the Month, and the Bead rectified or brought to the proper Meridian, or 12 as before has been Exemplified, according to the season of the year, viz. to the Summer 12 in Summer, and the Winter 12 in Winter, &c. Then bring the Bead to the Ecliptic (so rectified) and it will fall upon the Sun's place therein for that day, regard being had to the time of the year so upon the 18 of March, the Sun placed by the falling of the Bead will be about 8 degrees of *Aries*, and upon the 17 of October in 3 degrees of *Scorpio*.

(2) In finding the place of the Sun in the Ecliptic, 'tis necessary to know which

34 *The Use of a Portable Instrument,*
which way the *Sun* declines from the
Aequator, for if he declines *North*
the character belonging to his place
is above the *Ecliptick*, if *South* beneath
it. Now for as much as the *Bead* will
fall between two *Characters*, you may
know which it is by a *Second* days
observation, as for Example, let the
20th. of *August* be proposed, the
Thred being plac'd upon the day,
bring the *Bead* to the *Summer Meri-*
dian, which will shew that the *Sun* is
then in its *Northern Declination* (be-
cause the *Beads* very plainly shews
the same) and the *Thred* being moved
falls either upon the 7th. degree of
Virgo, or the 30 degree of *Aries*,
which the time of the year will plain-
ly distinguish; for *Aries, Taurus,*
Gemini, Cancer, Leo, Virgo, are the
Northern or Summer Signes, and
Libra, Scorpio, Sagittary, Capricorn,
Aquary, and Pisces, are the *Southern*
or *Winter signes*, and this proposition
will

will be found exceeding easie by a little practise.

3. If the *Thred* be laid upon the degree of the *Suns* place in the *Ecliptick*. Exactly it will cut in the *Limb* of the *Quadrant* the *Right Ascension* of the *Sun*; So the *Suns* place being 4 degrees of *Gemini*, the *Thred* laid upon this degree will cut 62 degrees in the *Limb* for the *Suns Right Ascension* required; but if the *Sun* has passed about 90 degrees from *Aries* or more then 3 *Signes*, then there must be more then 90 degrees allowed to the *Right Ascension*. Thus if degrees of the *Sun* between *Aries* and *Cancer*, then his *Right Ascension* is the very degrees cut by the *Thred* in the *Limb*; but if the *Suns* place be between *Cancer* and *Libra*, then to the first *Quadrant* you must add those degrees cut by the *Thred* in the *Limb* counting backwards from the *Sigher* side, if between *Aries*, and *C. pricorn* then to

36 *The Use of a Portable Instrument,*
180 degrees, add what the Thred cuts, if between *Catricorn* and *Aries*, then to 270 degrees add the degrees cut by the Thred in the Limb, counting backwards again, and you have the *Suns* true *Right Ascension* desired: So if the *Sun* be in 16 degrees of *Cancer* though the Thred falls upon 62 as before, yet the complement thereunto must be added viz. 28 degrees, and so the R.A. will be 118 gr. So upon the 18th. of *March* the R.A. is but 12 deg. but upon the 5th of *August* 126 deg. upon the 10th. of *October* 208 deg. and upon the 9th. of *March* 360 deg. and thus the business of *Right Ascension* is made as plain as possible may be to the meanest capacity *Ufus promptus facit.*

And thus having the *Right Ascension* given, you may by the converse work find the *Suns* place; for lay but the Thred to the *Suns* true *Right Ascension* in the Limb, and it will cross the *Suns* place, in the *Ecliptic* desired:

SECT.

S E C T. VI.

Of the Line of the Suns Declination.

THE Line of Declination is drawn from the Centre to the beginning of the Quadrant, and divided from the beginning of *Aries* downward to 23 degrees, 30 min.

Its use is thus, rectifie the Bead as before shewed, and bring it to the Line of *Declination* and you have the *Suns Declination* for that day. So if the *Suns* place given be the 4th. Degree of *Gemini* the Bead first set to this place and then moved to the Line of *Declination*, 'twill there shew it to be 21 degrees Declination Northerly from the *Aequinoctial*, and so if you have only the day of the Month given, you may presently find both the *Suns* place and declination also for that day,

38 *The Use of a Portable Instrument,*
day. Thus upon the 17th. of *October*
the Sun has 12 degrees of *Declination*
South. And Note, that if the *Bead* fall
upon the *Winter* 12, the *Declination*
is *South*: But if upon the *Summer* 12
'tis *North*, and having the *Declination*
only given, you may thereby find the
Suns place and day of the Month.

SECT. VII.

Of the Harizon.

1 **T**HE *Harizon* is represented up-
on the *Quadrant* by the *Arch*
drawn from the beginning of *De-*
clination towards the end of *February*
divided unequally, and Numbered by
10. 20. 30. 40. &c.

2. Having the place of the *Sun* or
day of the Month, to find the *Ampli-*
tude of the Suns Rising and Setting.

Let the *Bead* Rectified to the time
given,

given be brought to the *Horizon*, and there it shall shew the *Amplitude* required, so if the day of the Month given be the 15th. day of *May*, and the Sun in the 4th. degr. of *Gemini*, the Bead Rectified, and brought to the *Horizon* shall there fall upon 35 gr. 8 m. and this is the *Amplitude* of the Suns Rising from the *East*, and its setting from the *West*, which *Amplitude* is always *North*, if the Sun be in Northern signes, but when he is in Southern signes then 'tis always Southward, that is from the 10 of *March* to the 11 or 12 of *September North*, but all the other half year the *Amplitude* of the Sun is *South*erly, and so upon the 9th. of *April*, the *Amplitude* will be found Just 18 degrees *Northerly*, understand the same method in other operations.

3. The day of the Month, or the Suns place given to find the Suns *Assential difference*.

Let the Bead Rectified for the time
be

40 *The Use of a Portable Instrument,*
be brought to the *Horizon*, so shall the
Degrees cut by the Thred in the *Qua-*
drant shew the Suns Ascensional dif-
ference; so upon the 10th. of *May* the
Sun being in the last degree of *Taurus*,
or beginning of *Gemini*, let the Bead be
rectified and brought to the *Horizon*,
and then the Thred in the Limb of
the Quadrant shall shew the Ascensio-
nal difference to be 27 deg. 30 min. and
so upon the 15th. of *May* the Sun being
about 4 or 5 degrees of *Gemini*, the
Ascensional Difference will be found
near 29 deg. or rather 28 gr. 50 min.
so upon the 9th. of *April* the *Ascensi-*
onal Differences will be found 15 de-
grees. Now having this, you may
thereby find the time of the *Rising* and
Setting of the Sun, (which by some of
the former propositions may be gues-
sed at) but more accurately thus. If the
Ascensional Difference be converted
into time by allowing one hour for e-
very 15 degrees and 4 min. of an hour
for

for each degree, and this will shew how long the Sun riseth before Six in the *Summer* (that is from the 10th. of *March* to the 11th. or 12th. of *September* and after six of the Clock in *Winter*) so if the day proposed be the 15th. of *May*, and the place of the Sun and *Ascensional Difference* as before viz. 28 gr. 50 min. this converted into Time makes one hour and about 55 min. and so long did the Sun Rise before six viz. at 4 h. and 5 min. in the morning, and consequently sets so much after six, and in the *Winter* so much as the Sun rises after Six; so much it sets before six, hence the Length of the day and night is most easily obtained, for having the *Semidiurnal Ark* or time from Sun-rising to Noon, 'tis but doubling those Hours and Minutes, and you have the length of the day, so 7 hours 25 Min. doubled is 15 hours, 54 min. for the length of the day, *May* the 15th. which subtracted

42 *The use of a Portable Instrument,*
abstracted out of 24 hours, remains 8
hours 6 min. for the length of the
Night.

SECT. VIII.

Of the five Stars, &c.

THE Stars that were thought con-
venient (by the Author) to
put upon the Quadrant are first *Ala*
Pegasi a Star in the extremity of the
wing of *Pegasus*, in regard it wants but
6 minutes of time of the beginning of
Aries, and because 'tis not always to
be seen, four more were elected for
each Quarter of the Ecliptic, as *Oculus*
Tauri or the *Bulls eye*, whose Right As-
cension in time is 4 h. 15 m. then of
Cor Leonis, the *Lions Heart*, whose
Right

Right Ascension 9 h. 48 m. the next of *Antares* whose R. A. 13 h. 58 m. and the last of *Aquila* or the Vultures Heart whose R. A. is 19 h. 33 min. these five Stars have all of them Northern Declination, and of all others some of these will be seen (if the Air be clear) every night in the year, their use follows, viz.

1. The Altitude of either of these five Stars being known, to find the Hour of the Night, first, put the Bead to the Star which you intend to observe, then take his Altitude, and by that find how many hours he is distant from midnight, either before or after. Then from the Right Ascension of the Star Subtract the R. A. of the Sun converted into time, and Reserve the Difference; for this Difference being added to the observ'd hour of the Star from the Meridian or Midnight, shall shew how many hours the Sun is gone from Noon which is the hour of the Night.

2. As

44 *The Use of a Portable Instrument,*

2. As for example *May 15.* suppose the *Sun* be in 4 deg. of *Gemini*, and I set the Bead to *Arcturus*, and observing his Altitude, should find him to be in the *West* about 52 deg. high, and the Bead to fall on the hour-line of 2 Afternoon, the hour would be 11 hours, 50 min. past Noon, or but 10 min. short of midnight. For 62 gr. the R. Asc. of *Sun* converted into time makes 4 h. 8 min. which if we take out of 13 h. 58 min. the R. Asc. *Arcturus*, the Difference will be 9 h. 50 min. and this being added to 2 hours, the Observed distance of *Arcturus* from the meridian shews the Hour of the night to be 11 h. 50 m. as aforesaid.

3. Again to make the business more plain, suppose the 9th of *July* and the *Sun* be then in 26 gr. of *Cancer*, I should set the Bead upon *Oculus Tauri*, and Observing his Altitude should find him to be in the *East*, about 12 gr. high

and

and the Bead to fall on the Hour Line of 6 before Noon, which is 18 h. past the Meridian, the Hour of the night would be found somewhat more then 15 min. past 2 in the Morning, which may be proved thus, *viz.* The R. Asc. of the Sun is 118 gr. which converted into time (by allowing 15. degr. for an hour, and 4 min. for a degr.) it makes 7 h. 52 min. this subtracted out of 4 h. 15 the R. A. of *Ocul. Tauri* (adding the Circle, or 360 deg. that Subtraction may be made) the difference will be 20 gr. 23 min. and this being added to 18 h. (which was the observ'd Distance of the *Star* from the meridian) shews that the Sun (abating 4 hours or the whole circle) is 14 hor. 3 min. past the meridian, and therefore 23 min. past 2 in the Morning.

4. Now if you have a *Nocturnal* upon the Backside of the Quadrant, you need not use this Equation of Right Ascension,

46 *The Use of a Portable Instrument,*
Ascension, for knowing the time of the
year, when the Star will be South at mid-
night, you may bring that time to the
hour observed, then will the day of the
Month wherein you made your Obser-
vation, point at the hour of the night
required.

5. As in the first example, whereon
the 15th of *May*, the Bead set to *Arctu-
rus* fell upon the hour Line of 2 after-
noon, because this Star will be in the
South the 15th of *October* compleat at
Midnight, you may place the 14th. of
October at the hour of 2, so the 15th. of
May will point to 11 h. 50 m. as before,
the hour of the night desired.

6. And in the second example of the
9th. of *July*, where the Bead set to the
Bulls Eye fell on the hour Line of 6 be-
fore noon, because the *Bulls Eye* will be
in the *South* the 16 of *May* compleat at
Midnight, you may turn the 16th. of
May to the hour of 6, and thereby you
shall

shall find the 9th. of July to point unt^o
2 h, 23 min. as before.

SECT. IX.

Of the Quadrant.

1. **T**HE Quadrant hath 2 sides only divided, and the other 2 sides next unto the Centre may be supposed to be divided, each of them into 100 equal parts, that which is next to the Horizontal Line contains the parts of right shadow, the other next to the sights, the parts of contrary shadow, and its use, follows.

2. *Any point being given to find whether it be Level with the eye or not.*

If you lift up the Centre of the Quadrant, so as the Thred with the Plummert may play easily by the side of it, then Look through the sights to the
C place

48 *The Use of a Portable Instrument,*
place given, and if the thred fall upon
the Line A. B. drawn by the side of
the *Quadrant* (called the Horizontal
Line) then is the place given Level
with the eye; but if it fall within the
said Line on any of the Divisions then
it is higher, if without it must needs be
lower then the true Level of the eye.

3. *To find any hight above the Level of the
eye, or a distance at one Observation.*

Look through the sights to the Place,
going nearer or farther from it, till the
thred fall on 100 parts in the *Quadrant*
or 45 degr. in the *Quadrant*, so shall the
hight of the place above the level of
the eye, be equal to the distance 'twixt
the place and the eye. But if the Thred
fall on 50 parts of Right shadow, the
hight is but half the distance, if it fall
on 25 it is a quarter of the distance
if on 75 'tis three quarters of the dis-
tance, for as oft as the Thred falls upon
the

19 *called Gunters Quadrant.*

the Parts of Right Shaddow, it holds
this proportion, viz.

*As 100 to the parts upon which the Thred
falls.*

So is the distance to the hight required.

And so on the contrary.

*As the parts cut by the Thred are to 100
So the Hight to the Distance.*

4. But when the Thred shall fall up-
on the parts of Contrary shaddow, if
it fall on 50 parts the Hight is double
unto the Distance, if on 25 'tis 4 times
as much as the Distance. For as often as
the Thred falleth on the parts of Con-
trary shaddow the proportion is.

*As the parts cut by Thred are to 100 so is
the Distance unto the Hight.*

And the Contrary,

C 2

As

50 *The use of a Portable Instrument,*
As 100 are unto the parts cut by the
Thred, so is the Hight unto the Dis-
tance.

And what is here said of Hight and Distance, the same may be understood of hight, and shadow.

(5) *To find a Hight or distance at two*
Observations.

Suppose the Place which is to be Measured could not otherwise be approached, & yet it were required to find the Hight and the Distance; first I make choice of a Station where the Thred may fall on 100 parts in the Quadrant and 45 degr. in the Quadrant; then shall the Distance from the Object be equal to its Altitude: then if I go farther in a direct Line with the former Distance, and make choice of a second Station, where the Thred may fall on 50 parts
of

of Right shadow; then shall the Distance from the object to my Station be double to the Height of the object: wherefore if I measure the difference between the two Stations, it will be equal both to the first Distance and the Altitude of the object. But if I cannot make choice of such Stations then I take such as I may, as suppose one where the Thread falls upon 50 parts of Right shadow, and the second upon 40 and suppose the Altitude of the object 100, &c. The proportion holds.

As 50 parts are unto 100 the side of the Quadrant.

So 100 the supposed height unto 200 the Distance.

And as 40 parts as the second Station unto 100.

So 100 the supposed height unto 250 the Distance desired.

Wherefore the Difference between the two last Stations should seem to be

52 *The Use of a Portable Instrument,*
50, and then if in the Measuring of it
I find it to be either more or less, the
proportion holds as from the supposed
difference to the measured difference, so
from hight to hight, & from distance to
distance: as if the difference between the
two last Stations being Measured, were
found to be 30, then say, by the Rule
of proportion, or the Golden Rule.

As 50 the supposed difference unto
30 the true

So 100 the supposed hight unto 60
the true Altitude.

And as 200 the supposed distance un-
to 120 the true, so 150 at the second Sta-
tion unto 250 the Distance required.

(6) If standing upon a known Alti-
tude, and you would thereby know
the Distance, work as you did before
only that which was then the parts of
Right shadow must now be the parts
of contrary shadow, and that which
was then the parts of contrary shadow
must

called Gunter's Quadrant, 53
must now be the parts of Right shadow.

SECT. 10.

The Description and Use of the Nocturnal which is usually put upon the Back-side of Gunter's Quadrant.

1. **T** S an Instrument fitted chiefly to know the hour of the night by the Stars: It consists of two parts, the Fixed and the Movable, the Fixed part being the outermost Circle is divided in 24 parts representing the Hours of the Night, of which so many as are necessary are inserted, which are from 4 in the Afternoon till 8 in the Morning: each hour is divided into halves, quarters, and half quarters, and farther according as the Instrument will bear, this part must be fixed on the

34 *The use of a Portable Instrument,*
Back of some other Instrument, or it
may be used by it self.

2. The other part is *Movable* on
its Centre, the outward Circle next
the edg is divided into 365 parts, re-
presenting the days of the year, and
these are divided into Months which are
distinguished by Divisions and Figures to
know every day as is usual, & the Name
to each Month. Within this Movable
place there is inserted five Constellati-
ons of those Stars that are next the
North Pole, and in some a Star of the
first Magnitude called *Hircus*, all which
(without incumbering the Nocturnal
with more) are sufficient for this use.
There is likewise a Thred to be added,
lying on the Diameter from 12 to 12
which serves for a Meridian, to which
those that please may have added a Scale
of Declinations & a Circle divided into
360 degrees for finding the Right As-
cension, and Declination of these Stars,
but

but that work may be done with ease many other ways and is usually omitted in the Instrument.

2. The use of this Instrument is thus, First, Learn to know the Stars which are usually placed upon this Instrument, which is very easy from the bare Inspection of the Instrument it self, & they are most easily known in the Heavens; If you turn your self to the North, and there observe the seven great Bright Stars, in the greater Bear, called by most people *Charles's waine*, those four in a square form are in the Body of the Bear, the three other are in the Bear's taylor: having found these take Notice that the two Stars in the Square farthest from the Tail of the Bear, do in a straight Line point to another Star almost as Bigg as they are (which is in the tip of the little Bears taylor) and called the polar Star, or North Star, 'tis very near tho, not exactly in the Pole

56 *The Use of a Portable Instrument*

Pole. These being known the rest will be easily found out, by bare inspection of the Instrument.

3. The Stars being known, Now for the more certain finding of the hour of the night, it will be necessary to find a Meridian, which is a Line or Arch conceived to be drawn through or near the North Star, and so right over your head, & round about by the South just under your feet until it meet in the North Star again: or to spake more properly it is a Circle that passes through the North and South Poles & the Zenith & Nadir of the place, & divideth the Firmament in to the East and West Hemispheres, and to find this Meridian; I have already shewen in the use of the Quadrant. One good way may be in some Garden, or private place where you may clearly see the Stars both above and below the Pole, here pitch exactly upright, and at some distance two poles of a good length, let this be done just at Noon of the

the day, so that the shadow made (by the Sun at that time) of them both may be in a direct line, and this is a true Meridian. This being premised.

(4) If at any time of the night you would find the hour by the *Nocturnal*, stand by the Southermost of your Poles, (before set up) bring it in a right line with the other, so that the Pole by you may hide the other from your eye: then see what Stars are hid from your eye by these two Poles, either a bove or below the *Polar* or *North Star*, These are then upon the Meridian; Then coming to your *Nocturnal* by the help of your Thred bring the movable part thereof into the same position as you find the Stars in the Firmament, setting those upon the Meridian under the Thred, that you find to be hid from your eye, by the two Poles: then find in the movable part the day of the Month of your Observation, and just against it on the fixed part you shall find the hour of the Night.

5. But

56 *The Use of a Portable Instrument*

Pole. These being known the rest will be easily found out, by bare inspection of the Instrument.

3. The Stars being known, Now for the more certain finding of the hour of the night, it will be necessary to find a Meridian, which is a Line or Arch conceived to be drawn through or near the North Star, and so right over your head, & round about by the South just under your feet until it meet in the North Star again: or to spake more properly it is a Circle that passes through the North and South Poles & the Zenith & Nadir of the place, & divideth the Firmament in to the East and West Hemispheres, and to find this Meridian; I have already shewen in the use of the Quadrant. One good way may be in some Garden, or private place where you may clearly see the Stars both above and below the Pole; here pitch exactly upright, and at some distance two poles of a good length, let this be done just at Noon of the

the

the day, so that the shadow made (by the Sun at that time) of them both may be in a direct line, and this is a true Meridian. This being premised.

(4) If at any time of the night you would find the hour by the *Nocturnal*, stand by the Southermost of your Poles, (before set up) bring it in a right line with the other, so that the Pole by you may hide the other from your eye: then see what Stars are hid from your eye by these two Poles, either a bove or below the *Polar* or *North Star*, These are then upon the Meridian; Then coming to your *Nocturnal* by the help of your Thred bring the movable part thereof into the same position as you find the Stars in the Firmament, setting those upon the Meridian under the Thred, that you find to be hid from your eye, by the two Poles: then find in the movable part the day of the Month of your Observation, and just against it on the fixed part you shall find the hour of the Night.

5. But

(5) But as it would be a most certain way to have a Meridian for a while to exercise until you are well acquainted with the operation and performance, yet may you come very near to the matter (and near enough for common Use) without a Meridian thus, *viz.* when you know the Polar Star, place your body Directly upon the Star and imagining a Line drawn from the Zenith or point directly over your head through the said *Star*, and so directly down to the Earth, observe what Stars of those that are on your Plate, either over or under the Pole Star, are upon that supposed line which is your Meridian, then coming to your Nocturnal place the Movable part in the same Posture, and just against the day of the Month on the movable part is the hour of the night.

6. An example or two, will make all plain.

Suppose upon the first of *August*,
in

in the year 1684. finding by either of the former ways, that the two Stars of *Charles's wayne*, that are farthest from the Tayle of the Bear (which as I said before point directly to the Polar Star) are on the Meridian below the Pole, then coming to my *Nocturnal* I bring those Stars under my Thred below the Pole, and then looking for the day of the Month *August* 1st. I find that 'tis almost half an hour past one a clock in the Morning. And the same Night finding that Star in the Nose of the great Bear, to be on the *Meridian* below the Pole, I place this under my string in my *Nocturnal*, and seek the Day of the Month, and against it I find it to be half an hour past 10 at Night, and so upon *July* the 1st. finding the Star *Hircus* (a Star of the first Magnitude) to be on the Meridian below the Pole, I bring my movable part to 'its proper place (as before directed) and find it to be half an hour past nine a clock at night, *et sic de ceteris.*

Usus promptus facit

AN
APPENDIX.

SECT. I.

*The Description of the Universal
Ring-Dial, which sheweth the
Hour of the Day in any Part of
the World, and the Latitude
also.*

(1) **T**His Instrument is generally known, and very useful for most Persons, & a Pocket Companion. It is projected out of two Great Circles of the Sphere. Also an Axis and a little Ring to hang it by, and the making thereof well known to the Workman. (2) The greater Circle is the Grand Meridian, one Quadrant
OR

or *Quarter* thereof is divided into Ninety Degrees, to set it to the Latitude of the Place whereever you are. On the other side of the *Meridian* is a Quadrant of *Altitude*, to take the height of the *Sun*, thereby to find the Latitude of the place.

The lesser of these two Circles, (though both represent great Circles of the *Sphere*) is the *Equinoctial*, divided into 24 equal Parts or Hours, with their Halfs and Quarters, which are numbred but from Three in the Morning, to Nine at Night; the rest of the Hours are left out being seldom or never used.

(3) The Diameter or Broad-Plate hath a slit in the middle, and upon one side are the Months and days of the year, Graduated to every fifth day. On the other side is the *Sun's* declination from the *Equinoctial* to every fifth day, which is to be used with the Quadrant of *Altitude*, to find the Latitude.

titude of the place; The little Ring is made to slide along the *Quadrant*. with a small Tooth, to set it to the Latitude, and the use of this Portable and General Instrument is as Followeth.

SECT.

S E C T. II.

The use of the Ring-Dial in several Examples, first to find the Latitude, and Secondly the Hour of the day in any place throughout the habitable world, and therefore an Excellent Companion for all Travellers, Gentleman, or others of what degree, or Quality soever, 'tis fit they should accommodate themselves with both this and the Quadrant, the one being General, the other particular, and the one supplies the defects of the other.

(1) *For the Elevation of the Pole or Latitude of the Place.*

First set the hole in the moving piece (or Bridge so called by some) to the day of the Month, then turn the other side and right against
the

the hole is the *Suns Declination* for that day, The same day take the *Sun's Meridian Altitude* (which is his height at Noon every day) and may be performed by this Instrument thus: Put a pin into the hole, which you shall find in the greatest Circle, then move the *Tomb* to the beginning of the degrees in the Lesser *Quadrant*, and turn the pin next to the *Sun*, and that degree which is cut by the shadow of the pin is the *Sun's Altitude*, (which must be taken just at Noon as aforesaid)

2 If the time of your Observation be from the 10th. of *March* to the 13th. of *September* you must subtract the *Declination* out of the *Meridian Altitude* of the *Sun*, but from the 13th. of *September*, to the 10th. of *March*, adde, and the sum, or difference shall be the *Complement* of the *Latitude* or *Equinoctial* height, which being subducted out of 90 degrees, leaves the *Latitude* of the Place. Ex-

Example. I.

(1) Suppose the Latitude was unknown, and upon the 11th day of June you desire to find it, then by the former Rule find the Suns Declination for that day, which will be 23 deg. and 30 min. (or the Suns greatest Northern Declination, then take the Suns Altitude just at 12 of the clock, which at and near London, will be found 62 degrees then Subtract the Suns Declination 23 30 out of 62 deg. and the remainder will be 38 gr. 30 min. the complement of the Latitude or *Aequinoctial* height, which Subducted from 90 degrees leaves 51. 30 min. for the Latitude of London.

Example. II.

(2.) As the former Directions shews how to Observe the Latitude the Longest

longest day in the year, when the *Sun* has his greatest *Northern Declination*, so here admit that on the 10 of *December*, when the *Sun*s greatest *Southern Declination* is also 23 30 min. But the *Meridian Altitude* but 15 degrees: Adde these two Numbers together and they make 38 30 min which deducted from 90 deg. leaves the Latitude as before. 2. To find the Hour of the day. You must set the Tooth to the height of the Pole or Latitude of the Place, and slide the hole in the Plate to the day of the Month, then draw out the *Equinoctial* or lesser Circle, and as near as you can guess at the Hour and turn the hole to it, then hold the Instrument by the little Ring, and move it till the *Sun* shine through the hole upon the middle line in the *Equinoctial*, and that is the true hour of the day desired, and the *Meridian* as it hangeth lyes in the *Meridian* of the world truly North and South.

An.

AN
APPENDIX.*The Use of Gunter's Line in Measuring Board and Timber.*

1. *Admit a Board be 10 Inches Broad 20 and foot long I demand the Contents.*

Set one foot of the Compasses in 12 and extend the other to 10, then set one foot in 20, and extend the other Backwards and it will fall in 16 foot and a half which is the content of the Board required.

2. *Admitt*

2. *Admitt a Board be 15 Inches broad and 27 foot long I demand the Content.*

Set one foot in 12 and Extend the other to 15, then set one foot in 27 and extend the other forward, and it will fall in 34 foot which is the content requir'd

3. *Admitt a Board, to be 7 Inches and a half Broad, and 29 foot Long, I demand the Content.*

Set one foot in 12 and extend the other to $7\frac{1}{2}$, then set one foot in 29, and extend the other Backwards and it will be in 18 foot the content required.

4. *Admitt a Board to be 27 Inches Broad and 9 foot and a half long, I demand the content.*

Set one foot in 12, and extend the other to 27, then set one foot in $9\frac{1}{2}$, and extend the other forwards and it will fall in 21 and a Quarter which is the content desired.

5. *Admitt*

5. *A*
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other
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which

6. *A*
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Set
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AN APPENDIX.

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5. Admit a piece of Timber to be 8 Inches square and 20 foot long, I desire to know how many square feet there is contained in this piece of Timber.

Set one foot in 12, and extend the other to 8, then set one foot in 20 and extend that distance twice backward and it will fall in 8 foot 3 quarters, which is the true content required.

6. Admit a piece of Timber to be 9 Inches and $\frac{1}{2}$ square, and 27 foot long, I demand the content.

Set one foot in 12 and extend the other to $9\frac{1}{2}$ then set one foot in 27, and extend that distance twice backward, and it be will in 17 foot, the true content Required.

7. Admit a piece of Timber to be 18 Inches square and 9 foot long I demand the content.

Set on foot of the Compasses in 12, and extend the other to 18, then set one foot in 9 and extend that distance, twice forward and it will fall in 20 foot

foot and $\frac{1}{2}$ the content desired.

8. *Admit a piece of Timber to be 22 Inches square and 35 foot long; I demand the content.*

Set one foot in 12 and extend the other to 22, then set one foot in 35, and extend that distance of the Compass twice forward, and it will fall in 118 foot which is the content required.

9. *Admit I have the Breadth of a Board in Inches, to find how much in Length will make a Foot superficial.*

Extend the Compasses from the Breadth to 12, the same will reach from 12 to the content forward, if the Breadth be less than 12, and Backward if the contrary.



